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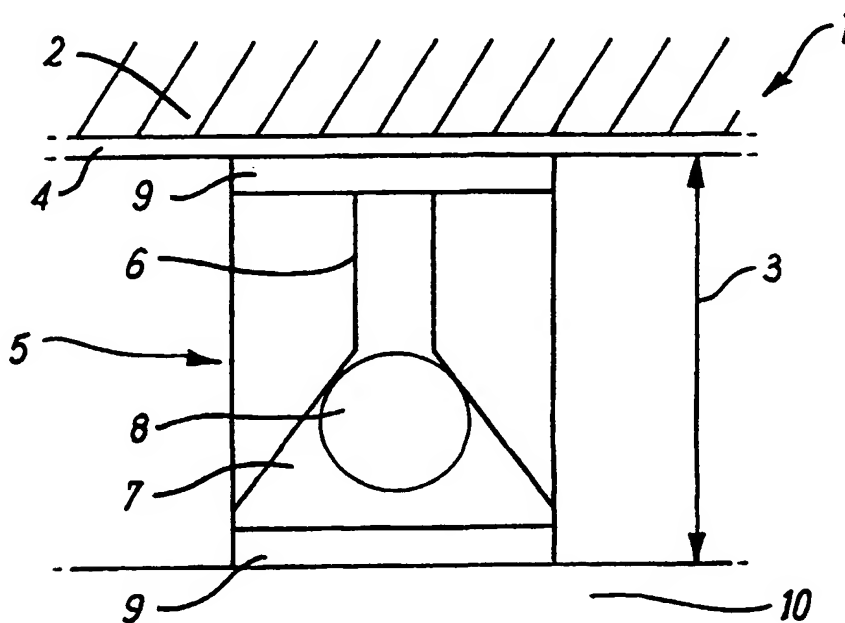
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(54) Title: LINED PIPELINE VENT



(57) Abstract: The present invention relates to apparatus for use in venting pipelines that have a plastic lining such as these used for transporting hydrocarbon fluids. A pipeline assembly comprises a pipeline (2), a corrosion resistance liner (3), and a micro-annulus (4) located between said pipeline and liner. The pipeline assembly also comprises a venting means (5) adapted for fitment in or through the corrosion resistance liner (3), wherein the venting means (5) allows gas to flow from the micro-annulus into the centre of the pipeline assembly but not in the opposing direction.



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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

1 LINED PIPELINE VENT

2

3 The present invention relates to apparatus for use in
4 venting pipelines that have a plastic lining. In
5 particular the present invention relates especially but
6 not exclusively to plastic lined pipelines used for
7 transporting hydrocarbon fluids.

8

9 Pipelines employed in the oil production industry are
10 commonly used to carry aggressive and corrosive
11 hydrocarbon fluids. This is problematic as pipelines of
12 this type are often run at considerable depths and it is
13 both costly and time consuming to repair and replace any
14 damage which may occur as a result of corrosion of the
15 pipeline. Unfortunately, corrosion resistant materials
16 are very expensive and hence undesirable for
17 manufacturing pipeline, which may be hundreds of metres
18 in length.

19

20 There are therefore considerable cost benefits in using
21 Carbon Steel pipelines lined with cheap corrosion
22 resistant liner. Indeed a number of plastics material
23 liners have previously been proposed and are commonly
24 used in process plant pipework. Although effective for

1 this purpose, the materials used in process plant
2 pipework systems are not suited for use in petrochemical
3 pipelines as they are typically supplied in short lengths
4 that are flanged rather than welded and operate at near
5 ambient temperatures and low pressures. They are
6 therefore not suitable for hydrocarbon pipelines which
7 are subject to hostile chemical and pressure conditions.

8
9 In applications where non-hydrocarbon pipelines, which
10 carry fluids with no gaseous content, are lined by a
11 plastic liner, it is typical to weld together significant
12 lengths of the steel pipeline and then to pull a
13 continuous plastics material pipe into the steel pipe to
14 form an inner lining. This is achieved by swaging or
15 squeezing the plastic material between rollers to make it
16 temporarily smaller such that it fits within the pipeline
17 in a loose fit. When the plastic material relaxes, or is
18 expanded, it achieves a close fit with the steel
19 pipeline. However there is no physical bond between the
20 pipeline and the plastic liner and as a consequence a
21 small micro-annulus exists between the two.

22
23 The plastic materials used are typically slightly
24 permeable. As a result, small gas molecules permeate out
25 of the fluid stream in the pipeline and pressurise the
26 micro-annulus between the steel pipeline and inner
27 plastic liner. During normal operational practices fluid
28 pressure in the pipeline fluctuates over time. When this
29 fluctuation is a pressure drop the gas trapped in the
30 annulus expands and collapses the liner, which can not be
31 re-flated thereafter without damage.

32
33 This invention relates to improvements to our earlier
34 British Patent Application Number 9817223.2 which teaches

3

1 of a venting apparatus for use in a plastic lined
2 pipeline. The venting apparatus is fitted in the
3 pipeline wall and comprises a through-hole to allow gas
4 to be vented out of the pipeline, and a porous element.
5 The porous element acts as a barrier to prevent the liner
6 deforming under pressure and clogging the through-hole.

7

8 Whilst this apparatus prevents the annulus from becoming
9 pressurised and therefore allows plastic lined pipelines
10 to be used for hydrocarbons, it is appreciated in the
11 present invention that it would be a distinct advantage
12 to provide a vent device which allows gas to flow back
13 into the flowline, as opposed to a vent device which
14 vents gas to the surroundings. It is appreciated that in
15 a number of circumstances it may be undesirable for the
16 gas contents of the fluid to be vented to the outside of
17 the pipeline, both from a safety and a commercial
18 perspective. In addition, by preventing emissions from
19 the pipeline, and retaining gas therein, the micro-
20 annulus between the pipeline and liner will not be
21 exposed to the external environment and potentially
22 corrosive materials and as a consequence corrosion of the
23 pipeline will be controlled. Similarly the liner is not
24 exposed to any external ambient pressure which may also
25 lead to collapse.

26

27 It is therefore an object of the present invention to
28 provide a venting apparatus, which prevents the annulus
29 between a pipeline and plastic liner from becoming
30 pressurised. In particular it is an object of the
31 present invention to provide a venting apparatus which
32 does not rely on emitting gas from the pipeline and
33 therefore protects the annulus between the pipeline and

1 plastic liner from excessive exposure to corrosive
2 material.

3

4 According to the present invention there is provided
5 a pipeline assembly comprising a pipeline, a corrosion
6 resistant liner, and a micro-annulus located between said
7 pipeline and liner, wherein the pipeline assembly also
8 comprises a venting means extending through the corrosion
9 resistant liner, wherein the venting means allows gas to
10 flow from the micro-annulus into the centre of the
11 pipeline assembly.

12

13 Preferably the liner is made from plastic.

14

15 In a preferred embodiment the venting means is inserted
16 through an aperture in the plastic liner. However, in an
17 alternative embodiment the venting means is retained by a
18 shoulder in the wall of the plastic liner.

19

20 Preferably the venting means is a pre-fabricated
21 assembly.

22

23 The venting means may be retained in the plastic liner by
24 threading, gluing or fusing.

25

26 Optionally the venting means has check means for
27 regulating fluid flow.

28

29 Said check means may be, for example, a sintered metal, a
30 sintered wire mesh, a ceramic material or a stainless
31 steel wire mesh. The check means can also be made from
32 various plastics and composite materials such as PEEK
33 (Poly Ether Ether Ketone) alloyed with Teflon (PAT).

34

1 Optionally, the venting means includes non-return valve
2 means.

3

4 The non-return valve means may comprise a spring biased
5 ball valve assembly.

6

7 Optionally the valve assembly comprises a moveable member
8 which is moveable between a first and second position,
9 wherein the moveable member is in the first position when
10 the pressure within the pipeline exceeds a set level, and
11 wherein the moveable member is in the second position
12 when the pressure within the pipeline falls below said
13 set level.

14

15 In the first position the moveable member prevents the
16 pipeline contents from exiting the pipeline.
17

18 In the second position the moveable member permits the
19 flow of gas into the pipeline.

20

21 Optionally the venting means may comprise a reed valve
22 arrangement formed directly in the liner.

23

24 In an alternative embodiment a sleeve member extends
25 circumferentially around the liner and longitudinally on
26 either side of the venting means so as to define a
27 lengthened venting path between the micro annulus and the
28 centre of the pipeline assembly.

29

30 Embodiments of the present invention will now be
31 described by way of example with reference to the
32 accompanying drawings in which:

33

1 Fig. 1 is a cross-sectional view of a first
2 embodiment of a pipeline assembly in accordance with
3 the present invention,

4

5 Fig. 2 is a cross-sectional end view of an
6 alternative embodiment of pipeline assembly,

7

8 Fig. 3 is a cross-sectional view of an alternative
9 embodiment of a pipeline assembly in accordance with
10 the present invention,

11

12 Fig. 4 is a cross-sectional view of a further
13 alternative embodiment of a pipeline assembly in
14 accordance with the present invention, and

15

16 Figs. 5 and 6 are cross-sectional views of two
17 designs of a further alternative embodiment of a
18 pipeline assembly in accordance with the present
19 invention.

20

21 Referring firstly to Fig 1 of the drawings a pipeline
22 assembly is shown generally at 1. The pipeline assembly
23 1, is comprised of a pipeline 2, which is lined by a
24 corrosion resistant liner 3, and an annular gap or micro-
25 annulus 4 defined in between the liner 3 and pipeline 2.
26 The corrosion resistant liner is typically made from a
27 plastics material. A venting means 5 is inserted into a
28 pre-drilled hole in the wall of the plastic liner 3. In
29 an alternative arrangement where a relatively thick
30 plastic liner 3 is used, the venting means 5 may be
31 adapted to sit on 'shoulders' within the plastic wall 3
32 thickness. The pipeline 2 is typically manufactured from
33 carbon steel and transports hydrocarbons, which flow
34 through the inside of the pipeline 10 .

1
2 The venting means 5 is a pre-fabricated unit which can be
3 inserted into the liner 3 at any time before said liner
4 is fitted into the pipeline 2. Typically the pre-
5 fabricated venting means 5 is inserted into the pre-
6 drilled hole of the liner 3 by threading, gluing or
7 fusing. It will be appreciated that the through hole of
8 the venting means 5 has specific design requirements such
9 as diameter, depth and shape to provide the most
10 effective control of corrosion.

11
12 As a consequence, the venting means 5 will typically be
13 precision engineered prior to insertion into the liner 3.
14 This prefabrication process allows the through hole 6 of
15 the venting means 5 to be of a more sophisticated design.
16 A further advantage of using a prefabricated venting
17 means is that more thermally and chemically inert
18 materials, such as PEEK or corrosion resistant metals can
19 be used, to ensure performance to specification
20 throughout life.

21
22 The venting means 5 acts to preserve the geometric
23 properties of the pre-drilled hole in the liner 3, that
24 is to say, it acts essentially as a hole opener. It will
25 be appreciated that as plastics have typically high co-
26 efficients of thermal expansion, large expansion forces
27 occur in the lining 3 as the pipeline 2 warms up. These
28 forces would tend to close any unsupported hole.
29 Similarly, some plastics tend to swell as they absorb
30 water and degrade from exposure to raw hydrocarbon
31 fluids, causing similar hole closure. Thus, the
32 important function of the venting means 5 is to maintain
33 the hole in the liner in an open configuration.

34

8

1 The number of venting means 5 required on the pipeline
2 assembly 1 will vary according to, for example, the
3 length and type of pipeline 2 used. For example the
4 number of vents could range from one vent every 30 to 40
5 metres of pipeline (that is one vent every few joints) to
6 one vent every few metres (that is many vents in one
7 joint).

8

9 In use the through-hole is engineered to slow the
10 velocity of fluid and minimise "eddies" and vortices at
11 the steel surface, in order to slow the replenishment of
12 the corrosive medium. The through-hole is also designed
13 to prevent any corrosion product from being washed away,
14 thus effectively forming a protective layer to the
15 substrate steel.

16

17 The example embodiment of the vent assembly shown in Fig
18 1 comprises a main body, with a through hole 6 through
19 which gas molecules can pass. The venting means 5 also
20 comprises a non-return valve 7 having a ball 8 which
21 minimises the amount of product entering the micro-
22 annulus. The valve assembly may also comprise a check
23 means 9 for regulating fluid through the through-hole 6.
24 The check means 9 has a closely controlled porosity and
25 permeability and hence allows the fluid exchange process
26 over the vent assembly to be closely controlled.

27

28 In use, the pipeline 2 will be subject to high pressure
29 and temperature, under which conditions the plastic liner
30 will have some permeability to the gas within the
31 hydrocarbon product contained in the pipeline 2. As a
32 result a small quantity of gas can enter the micro-
33 annulus, by virtue of the permeability of the plastic
34 liner 3. The venting means 5 maintains the pre-drilled

1 hole in the liner 3 in an open configuration and
2 therefore allows gas to re-enter the pipeline from the
3 micro-annulus.

4

5 The vent assembly embodiment shown in Figures 2 and 3, is
6 also located in a pre-drilled hole of a plastic liner in
7 a pipeline and comprises a moveable member 11, typically
8 in the form of a disc, which during normal operation, is
9 pushed against the vent body 12 by the oil pressure
10 within the pipeline. This prevents the product from
11 leaving the inside of the pipeline 10 and entering the
12 micro-annulus 6. However, in the event that the pressure
13 inside the pipeline 10 falls, and there is a
14 corresponding increase in pressure in the micro-annulus
15 6, a pressure difference will arise across the liner 3,
16 and the gas pressure will push the disc 11 off the vent
17 body 12 and allow gas to flow back into the centre of the
18 pipeline 10. The end of the vent, shown in Figure 3, is
19 shaped to "catch" the disc 11 when the gas pressure
20 increases and accordingly will prevent the disc 11 from
21 being lost within the contents of the pipeline 10.

22

23 It will be appreciated that whilst the embodiments shown
24 in Figures 1 to 3 employ non-return valves and moveable
25 members, the vent assembly may comprise a much simpler
26 design.

27

28 Figures 4 and 5 illustrate such a design, being similar
29 to that shown in Figure 1 but having no moving parts.
30 The vent assembly shown in Figures 4 and 5 simply acts to
31 prevent the hole in the liner 3 from becoming closed
32 under the effects of the pressure and heat of the
33 pipeline contents 10. The hole in the liner 3 is
34 sufficiently small to allow pressure to be relieved

1 through it, however there is no free circulation of
2 corrosive medium behind the liner 3.

3

4 The embodiment shown in Figure 6 is of a similar simple
5 design, but has a check means 9 for regulating fluid flow
6 through the through hole, as described in Figure 1.

7 Various materials are envisaged for the check means 9,
8 for example sintered metal, sintered wire mesh or
9 porcelain/ceramic type material. Additionally the check
10 means 9 can be made from various plastics and composite
11 materials such as PEEK (Poly Ether Ether Ketone) alloyed
12 with Teflon (PAT). The check means 9 acts as a baffle
13 between the surface requiring protection, that is the
14 carbon steel pipeline 2, and the corrosive product, which
15 typically is the hydrocarbon inside the pipeline 10 and
16 has a closely controlled porosity and permeability which
17 allows the fluid exchange process to be closely
18 controlled.

19

20 In a yet further embodiment, and in order to increase the
21 tortuosity of the path between the access point of the
22 corrosive medium and the surface of the steel, it may be
23 desirable to have a number of liners arranged
24 concentrically, each with vent assemblies sufficiently
25 offset to allow the rapid equalisation of pressure but to
26 effectively eliminate free transfer of the corrosive
27 medium between the steel and pipeline contents.

28

29 In a still further embodiment an additional plastic
30 sleeve may be provided over the section of plastic pipe
31 containing the vent, so that any product that did travel
32 through the vent would have an additional distance to
33 travel before coming into contact with the steel pipe
34 wall, thus reducing the likelihood of corrosion on the

11

1 inside of the steel pipe as turbulent fluid straight from
2 the pipe would never be in immediate contact with the
3 steel.

4

5 The sleeve would be added after the liner had been swaged
6 to fit the host pipe, but before the liner itself was
7 inserted into the pipe. It is envisaged that the sleeve
8 would be applied by wrapping it around the liner pipe.

9

10 The advantage of the present invention lies in the fact
11 that the vent assembly acts to allow gas to flow from the
12 micro-annulus between the pipeline and liner, back into
13 the contents of the pipeline as opposed to venting the
14 gas to the surroundings. As a result there are no
15 emissions from the pipeline. This has both commercial
16 and environmental advantages and pollution of the
17 environment surrounding the pipeline will be greatly
18 reduced.

19

20 Although various arrangements of vent assembly have
21 already been discussed it is not envisaged that the
22 examples discussed should be limiting and other possible
23 arrangements will be readily apparent to the skilled
24 engineer. One such arrangement envisaged is that of
25 having the vent shaped as a reed valve. The "vent" would
26 be made by using a chisel to gouge into the liner,
27 creating a sliver of liner which would remain closed
28 until subjected to a pressure difference, which would
29 allow the release of the pressure trapped in the annular
30 gap. The reed valve would be formed on the inside of the
31 plastic liner, at some point prior to its insertion into
32 the steel host pipe.

33

12

1 Modifications and improvements may be made without
2 departing from the scope of the invention herein
3 intended.

4

5

6

Claims:

1. A pipeline assembly comprising a pipeline, a corrosion resistance liner, and a micro-annulus located between said pipeline and liner, wherein the pipeline assembly also comprises a venting means extending through the corrosion resistance liner, wherein the venting means allows gas to flow from the micro-annulus into the centre of the pipeline assembly.
2. A pipeline assembly as claimed in Claim 1 wherein the venting means is inserted through an aperture in the plastic liner.
3. A pipeline assembly as claimed in Claim 2 wherein the venting means is retained by a shoulder in the wall of the plastic liner.
4. A pipeline assembly as claimed in any one of the preceding claims wherein the venting means is a pre-fabricated assembly.
5. A pipeline assembly as claimed in any one of the preceding claims wherein the venting means is retained in the plastic liner by threading, gluing or fusing.
6. A pipeline assembly as claimed in any one of the preceding claims wherein the venting means has check means for regulating fluid flow.
7. A pipeline assembly as claimed in Claim 6 wherein said check means is of a construction selected from

1 a group comprising a sintered metal, a sintered wire
2 mesh, a ceramic material, a stainless steel wire
3 mesh, a plastics material and composite materials
4 such as PEEK (Poly Ether Ether Ketone) alloyed with
5 Teflor (PAT).

6

7 8. A pipeline assembly as claimed in any one of the
8 preceding claims wherein the venting means includes
9 non-return valve means.

10

11 9. A pipeline assembly as claimed in Claim 8 wherein
12 the non-return valve means comprises a spring biased
13 ball valve assembly.

14

15 10. A pipeline assembly as claimed in Claim 8 wherein
16 the valve means comprises a moveable member which is
17 moveable between a first and second position,
18 wherein the moveable member is in the first position
19 when the pressure within the pipeline exceeds a set
20 level, and wherein the moveable member is in the
21 second position when the pressure within the
22 pipeline falls below said set level, wherein in the
23 first position the moveable member prevents the
24 pipeline contents from exiting the pipeline and
25 wherein in the second position the moveable member
26 permits the flow of gas into the pipeline.

27

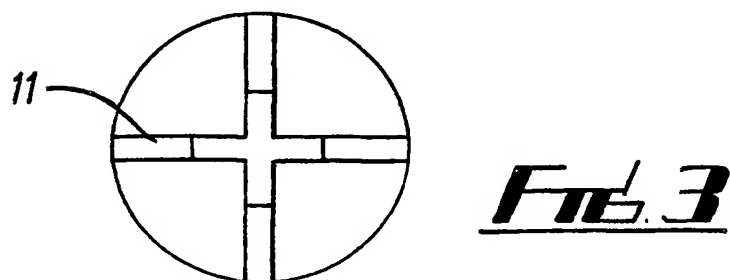
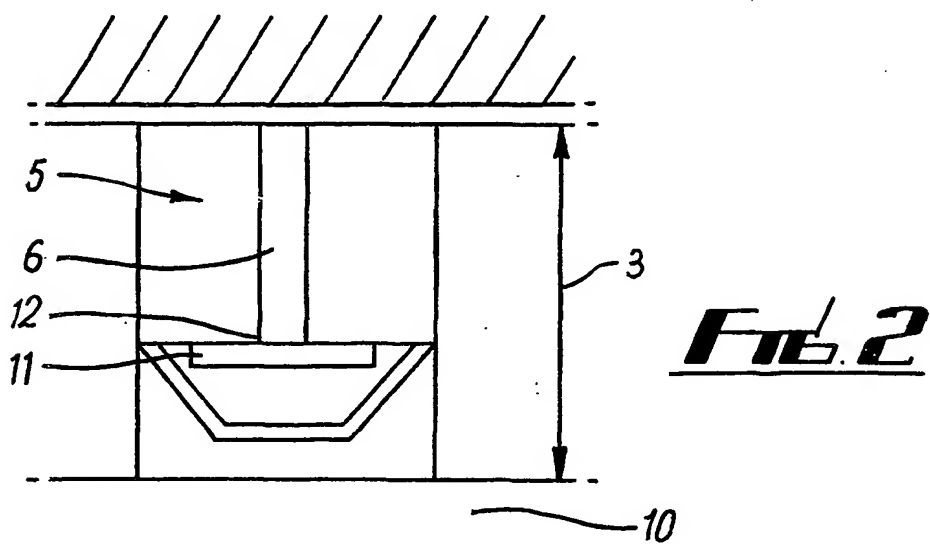
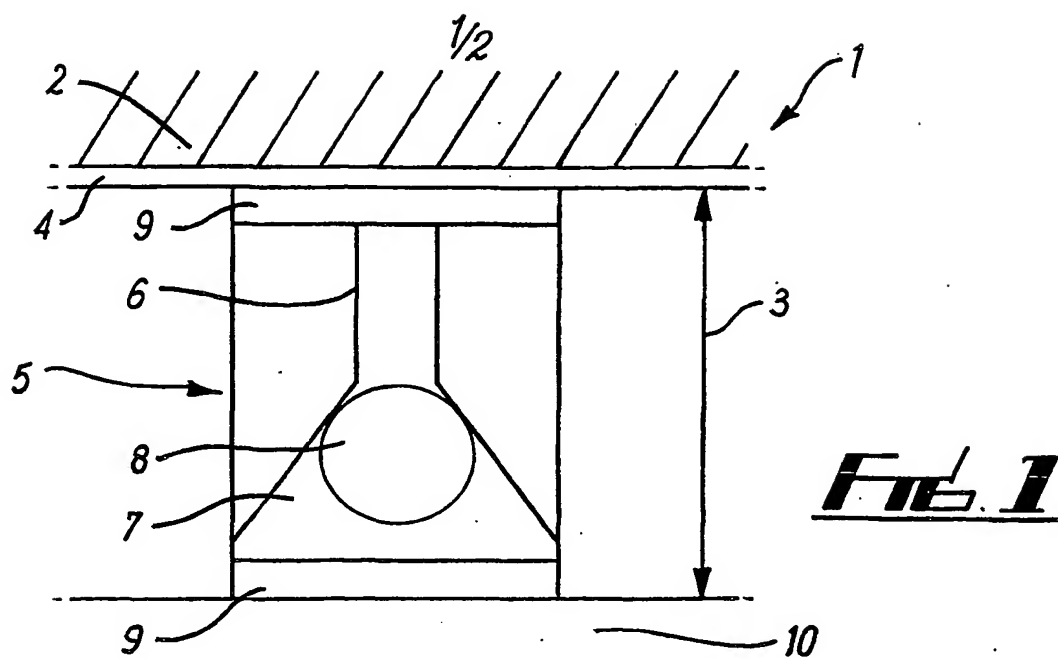
28 11. A pipeline assembly as claimed in Claim 1 wherein
29 the venting means comprises a reed valve arrangement
30 formed directly in the liner.

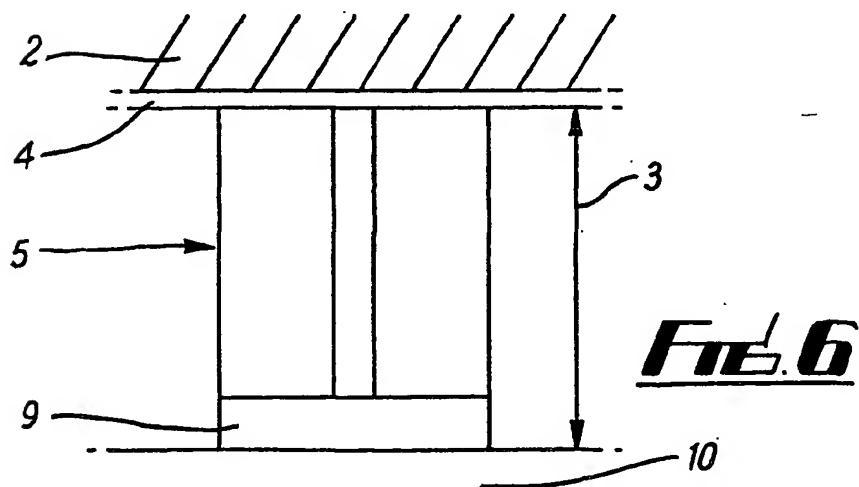
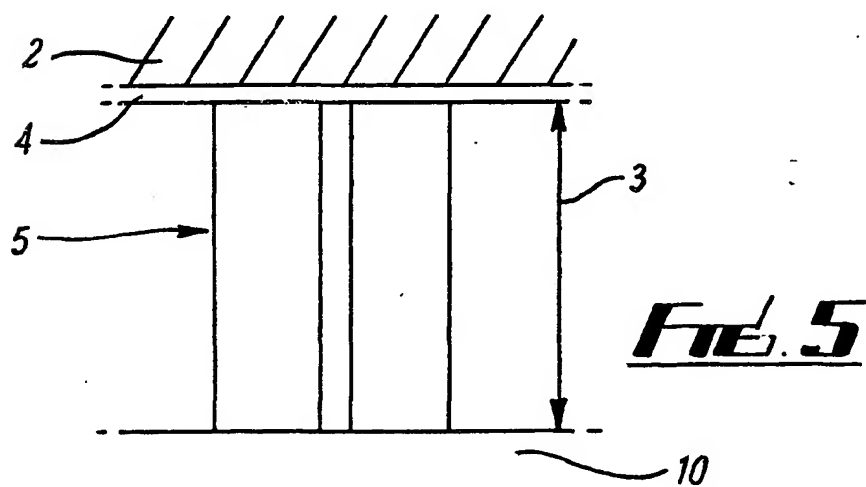
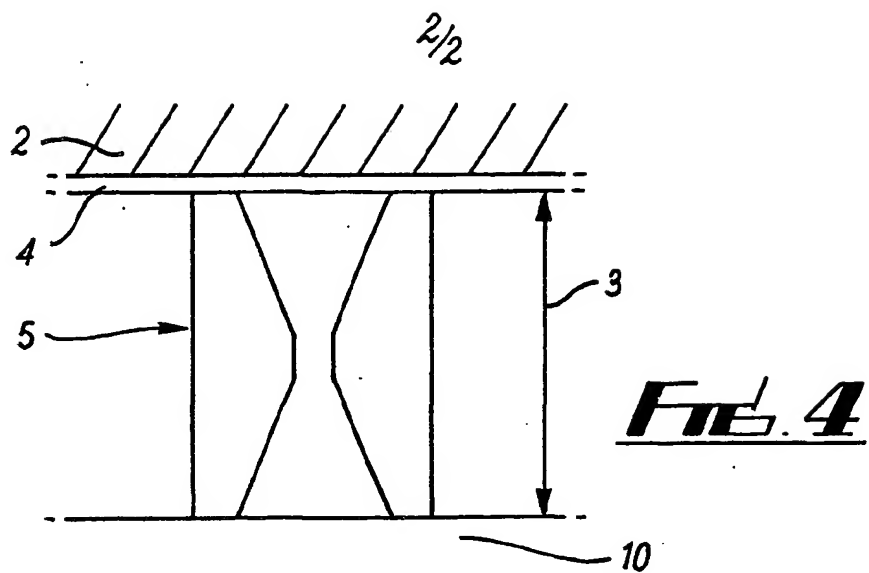
31

32 12. A pipeline assembly as claimed in any one of the
33 preceding claims wherein a sleeve member extends
34 circumferentially around the liner and

15

1 longitudinally on either side of the venting means
2 so as to define a lengthened venting path between
3 the micro annulus and the centre of the pipeline
4 assembly.
5





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B. FIELDS SEARCHED

IPC 7 F16K F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Relevant to claim No.

1-12

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☒ Patent family members are listed in annex.

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>GB 2 115 103 A (YARNELL IAN ROLAND) 1 September 1983 (1983-09-01) page 2, line 28 - line 44 figure 1</p> <p>-----</p>	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/GB 01/04546

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 0008368	A	17-02-2000	AU 5430299 A WO 0008368 A1	28-02-2000 17-02-2000
WO 9817938	A	30-04-1998	AT 210260 T AU 4293897 A BR 9712654 A WO 9817938 A1 DE 59705705 D1 EP 0932793 A1 JP 2001503122 T PL 333102 A1	15-12-2001 15-05-1998 21-12-1999 30-04-1998 17-01-2002 04-08-1999 06-03-2001 08-11-1999
US 4100940	A	18-07-1978	NONE	
GB 2115103	A	01-09-1983	AU 1109283 A EP 0098855 A1 WO 8302490 A1 ZA 8300185 A	28-07-1983 25-01-1984 21-07-1983 26-10-1983